

Integrated SiC Super Junction Transistor-Diode Devices for High-Power Motor Control Modules Operating at 500 C, Phase I

Completed Technology Project (2011 - 2011)



Project Introduction

Monolithic Integrated SiC Super Junction Transistor-JBS diode (MIDSJT) devices are used to construct 500

- o C capable motor control power modules for direct integration with the exploration rovers required to operate in Venus-like environments. The Phase I of this proposed work will focus on the integrated MIDSJT device development and high-temperature packaging. Phase II will focus on the integration of the MIDSJT devices to construct full 3-Phase Inverter Motor Control Modules. Although SiC is the semiconductor material of choice for fabricating high-temperature (> 150

- o C) power electronics, existing SiC MOSFET and JFET based transistor device technologies perform poorly at temperatures exceeding 200

- o C. The proposed gate oxide-free Integrated MIDSJT device technology will overcome several problems associated with existing SiC device technologies by: (A) exhibiting desirable normally-OFF operation yet best-in-class on-state characteristics at temperatures as high as 500

- o C, (B) eliminating parasitic inductances/capacitances associated with interconnecting discrete devices, and (C) eliminating high-temperature gate oxide reliability issues. Special device designs and fabrication processes will be investigated in this work for reliable device operation at 500

- o C. Novel power device packaging techniques in the areas of power substrate, die-attach, chip metallization and wire bonds will be explored to demonstrate reliable module operation at 500

- o C after several thermal cycles.



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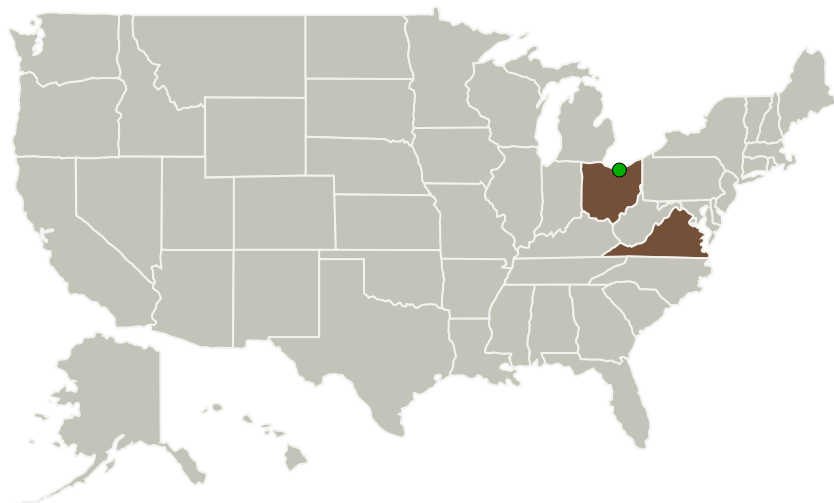
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
GeneSiC Semiconductor Inc.	Lead Organization	Industry Minority-Owned Business, Small Disadvantaged Business (SDB)	Dulles, Virginia
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

Ohio	Virginia
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Project Transitions

**February 2011:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

GeneSiC Semiconductor Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

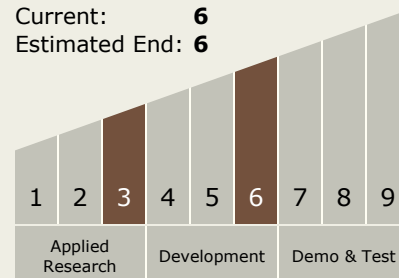
Carlos Torrez

Principal Investigator:

Siddarth Sundaresan

Technology Maturity (TRL)

Start: 3
Current: 6
Estimated End: 6



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✓ **September 2011:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138674>)

Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
 - └ TX05.2 Radio Frequency
 - └ TX05.2.2 Power-Efficiency

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System